

MHSA Science – March 2014

Science Grade 11

The table below shows the entire eleventh-grade science test design. Scores are based on common items only, half of which are released and can be found in this document.

Test Design

CONTENT AREA	COMMON		FIELD TEST ITEMS		TOTAL ITEMS PER STUDENT		BASE TESTING TIME	POINTS
	MC	CR	MC	CR	MC	CR		
SCIENCE	40	4	8	1	48	5	120 MIN.	56

Each item on the MHSA measures a content standard of Maine's 2007 *Learning Results*.

Science Content Standards Assessed on the MHSA

D. The Physical Setting

1. Universe and Solar System
2. Earth
3. Matter and Energy
4. Force and Motion

E. The Living Environment

1. Biodiversity
2. Ecosystems
3. Cells
4. Heredity and Reproduction
5. Evolution

Item Information Chart

Please refer to the item information chart on the next page for in-depth information on each science released item. The released item numbers in the chart correspond to item numbers in the practice test and on the MHSA Item Analysis Report.

Constructed-Response Scoring Guides

A constructed-response scoring guide includes score point descriptions used to determine the score. Training notes that follow the scoring guide provide in-depth descriptions or particular information also used to determine the score.

Student Work

At least one sample student response is provided for each score point with annotations that explain the reasoning behind the assigned score.

MHSA Science Released Item Information

Released Item Number	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22
Practice Test Page Number	1	1	1	1	2	2	2	2	2	3	3	3	4	4	4	4	5	5	5	5	6	7
Content Strand (Maine 2007 Learning Results)	D1	D1	E1	D3	E3	E4	E1	D4	E1	E4	E3	D4	D3	D1	E4	D3	D3	E3	D4	D2	E5	D4
Depth of Knowledge Code	1	1	2	2	2	1	2	2	2	2	1	2	2	2	1	3	3	2	2	3	3	2
Item Type	MC	CR	CR																			
Possible Points	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	4	4
Answer Key	A	D	A	B	C	A	B	B	A	A	A	D	C	B	A	B	C	B	C	A		
% Who Chose A or Earned 1 Point	42	8	88	4	17	62	14	11	78	72	54	12	2	2	25	9	10	7	12	41	24	38
% Who Chose B or Earned 2 Points	28	18	2	42	17	12	57	75	7	18	11	9	20	74	43	33	24	78	12	7	30	24
% Who Chose C or Earned 3 Points	13	4	3	8	45	9	4	6	2	7	8	7	69	14	13	30	29	7	45	44	24	10
% Who Chose D or Earned 4 Points	10	67	6	39	14	12	24	6	12	1	24	70	8	9	17	21	32	7	22	4	9	2
Statewide Average Student Score																					1.90	1.23

Depth of Knowledge Code

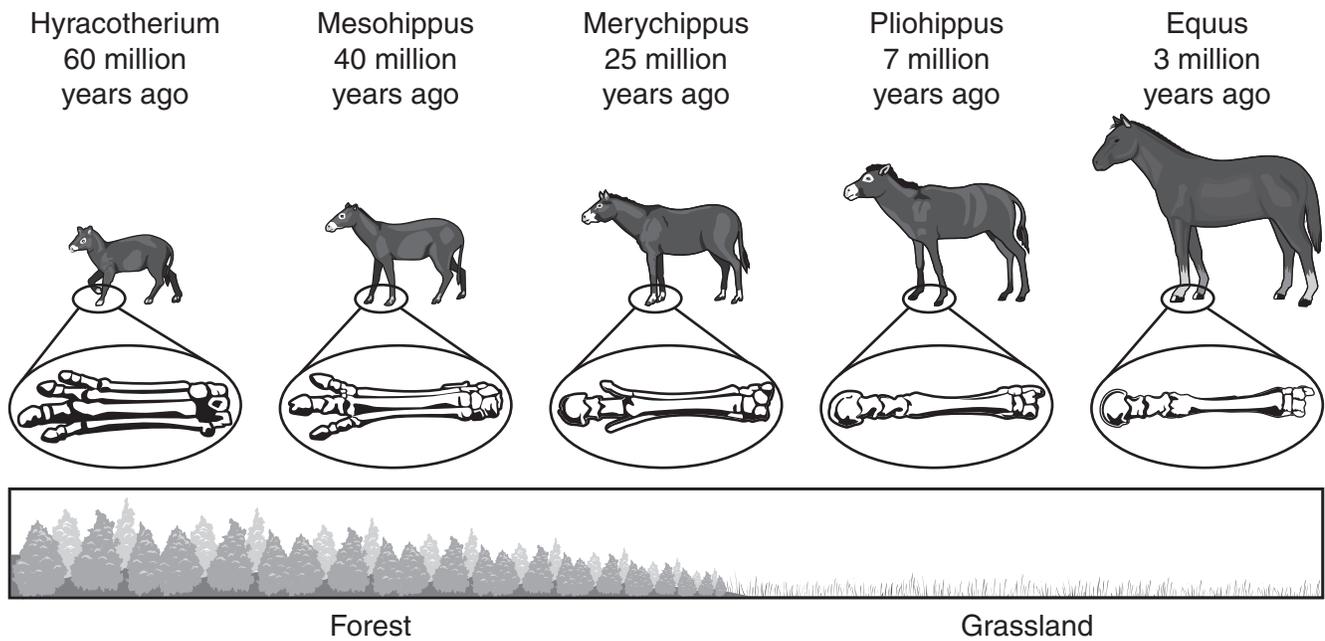
Item Type: MC = multiple choice, CR = constructed response

Answer Key: the letter of the correct answer choice

MHSA Science Released Items – Student Work

Constructed-Response Item 21

21. The diagram below shows changes to the foot and leg bones of horses over time.



- a. Based on the information about horses shown in the diagram, provide a conclusion about the changes in horses over the last 60 million years. Use evidence from the diagram to support your conclusion.
- b. Describe the scientific ideas about the interaction of organisms and environments that lead to changes in a species over time **and** explain how this connects to your conclusion in part a.

Scoring Guide for Constructed-Response Item 21

Score	Description
4	The response demonstrates a thorough understanding of the premise of biological evolution, citing evidence from the fossil record and evidence based on the observation of similarities within the diversity of existing organisms. The response provides a conclusion about the changes in horses over the last 60 million years and includes evidence that connects to their conclusion AND describes generally the scientific ideas about the interaction of organisms and environments that lead to changes in a species over time and explains how this connects to their conclusion in part a. The response has no errors or omissions.
3	The response demonstrates a general understanding of the premise of biological evolution, citing evidence from the fossil record and evidence based on the observation of similarities within the diversity of existing organisms. The response has one error/omission overall.
2	The response demonstrates a limited understanding of the premise of biological evolution, citing evidence from the fossil record and evidence based on the observation of similarities within the diversity of existing organisms. The response has two errors/omissions overall.
1	The response demonstrates a minimal understanding of the premise of biological evolution, citing evidence from the fossil record and evidence based on the observation of similarities within the diversity of existing organisms. The response has one piece of correct information.
0	The response is incorrect or irrelevant to the skill or concept being measured.
Blank	No response.

Training Notes for Constructed-Response Item 21

a. Possible responses include:

- Horses changed gradually over time.
- The size and shape of horses have changed over time.
- The configuration of the horse's foot has changed over time.
- The number of toes decreased over time.
- The type of food that horses ate changed over time.

b. Possible responses include a discussion of their conclusion and the connection with reasonable evidence from the diagram.

Possible response must include a discussion of how natural selection can lead to evolution of a species over time (e.g., traits of an organism that help it survive are selected for and carried forward in the species over time) **AND** the response must also connect to the specific ideas in their conclusion.

a. Horses changes in food source, and preferred habitat has shaped their evolution over the last 60 million years. Being the early forest dwelling Hyracotherium the small size and fingered paws helped it run, dig and be able to duck and maneuver around trees and branches without the burden of cumbersome size. As evolution progressed and the environment of the horse changed the feet began coming together as hooves which helped in running, working, and preventing injury in the grasslands they were now moving towards. In regards to their size, they didn't need to be the small swift sleeky Meschippus any more, the Equus lived on open lands where size and speed made a survivor.

b. When an organism is living, or a group of organisms together science states that in some cases an animal species must "adapt or go extinct." If an animal species needs to survive the traits that work will be passed down from survivors through sexual reproduction and the non-helpful traits will die off. Hooves and size were obviously necessary for the survival of the horse so those traits were made the "norm" thus making the Equus of today

Summary annotation statement:

In part a, this response presents a detailed discussion of the adaptive changes in horses over 60 million years with strong evidence from the diagram including size, bone structure and habitat. In part b, this response outlines the concept of interactions between organisms and their environments that lead to changes in a species over time including helpful traits being "passed down from survivors through sexual reproduction" and connects those principles back to their relevance to the evolution of the horse as outlined in part a. This response is thorough and receives a score of 4.

a. Horses have gotten bigger in the past 60 million years. As the environment changed from forest to field the bones of the horse changed from more of a foot to a hoof. This can be explained because of the rough terrain in a forest it would need a more flexible foot.

b. Organisms adapt to their surroundings so if one organism is born with a gene that makes it able to survive better or easier, chances are that it will mate and spread that gene.

Summary annotation statement:

In part a, this response offers a concise conclusion about the evolution of the horse, generally supported by evidence from the diagram. In part b, this response offers an explanation of how natural selection can lead to changes in a species over time. There is no connection back to how this concept relates to the evolution of the horse described in part a. This response is general and receives a score of 3.

A. Over the last 60 million years horses have gone from having toe like things to just hooves. I think this is because they originated from the forest, which the toes would help with. While now they live in flat grounds so hooves would be most appropriate.

B.

Summary annotation statement:

Part a offers an understanding of the evolution of the horse over the past 60 million years and includes evidence from the diagram (the adaptation of toes to hooves) and a limited discussion of how changes to those features would have been helpful in the new environment. Part b is not attempted. This response is limited and receives a score of 2.

Sample 1-Point Response with Annotations for Constructed-Response Item 21

A.) As horses have moved into the grasslands, they have grown larger and they have lost their toes for hooves.

Summary annotation statement:

This response offers a minimal view of the changes in horses over the past 60 million years by indicating “they have grown larger” and “they have lost [their] toes for hooves,” and offers a weak connection to the environment by indicating that the horses “have moved into the grasslands.” Part b is not attempted. This response is minimal and receives a score of 1.

Sample 0-Point Response with Annotations for Constructed-Response Item 21

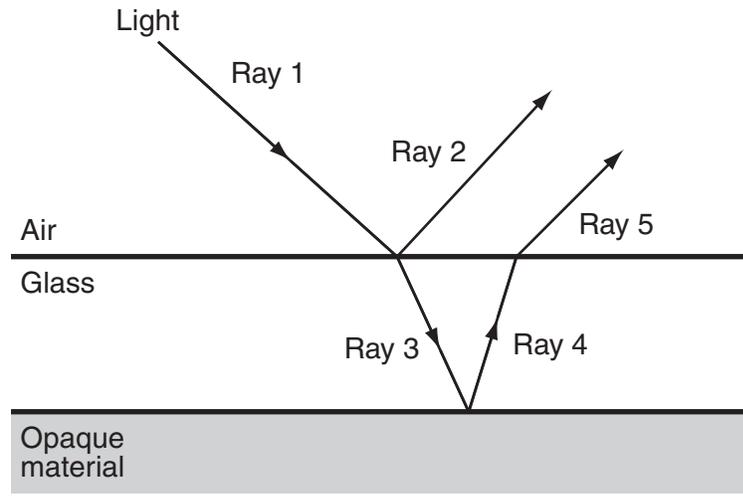
A. Some have toes and some don't have toes.
B. One is taller than the other.

Summary annotation statement:

This response does not address changes in horses over time. It focuses instead on the specific differences between the drawings. No credit is earned.

Constructed-Response Item 22

22. The diagram below shows the wave behavior of light in air and in glass.
Rays 1, 2, and 5 are in air. Rays 3 and 4 are in glass.



- Identify and describe two wave behaviors that are shown in the diagram. Use evidence from the diagram to support your answer.
- Describe two differences between Ray 1 and Ray 3. For each difference, explain your answer.

Scoring Guide for Constructed-Response Item 22

Score	Description
4	The student demonstrates a thorough understanding of how light waves interact with matter. The response correctly identifies and describes both reflection and refraction as shown in the diagram and provides evidence for both wave behaviors. The response describes and explains two ways Ray 1 and Ray 3 differ. The response has no errors or omissions.
3	The response demonstrates a general understanding of how light waves interact with matter. The response has one error/omission overall.
2	The response demonstrates a limited understanding of how light waves interact with matter. The response has two errors/omissions overall.
1	The response demonstrates a minimal understanding of how light waves interact with matter. The response has one piece of correct information.
0	The response is incorrect or irrelevant to the skill or concept being measured.
Blank	No response.

Training Notes for Constructed-Response Item 22

Part a: One wave behavior is reflection, the bouncing of a wave off a boundary. The evidence for reflection is Ray 2 or Ray 4 in the diagram.

The other wave behavior is refraction, the bending of a wave as it passes from one medium to another. The evidence for refraction is Ray 3 and Ray 5.

Part b: Differences between Ray 1 and Ray 3 include:

- They travel at different speeds. Ray 1 is traveling faster than Ray 3.
- They have different wavelengths. Ray 1 has a longer wavelength than Ray 3.
- They are traveling in different directions. Ray 1 and Ray 3 are not parallel.
- The intensity of Ray 1 is greater than Ray 3.

a) Light refraction and reflection are in the diagram. Light is bent, or refracted, as ray 1 becomes ray 3 and as ray 4 becomes ray 5. Light is reflected as ray 1 becomes ray 2 and as ray 3 reflects off the opaque surface and becomes ray 4.

b) The intensity of ray 3 is less than that of ray 1 because some of the electromagnetic energy ray 1 had is not present in ray 3 as it was reflected to create ray 2. Ray 3 is also at a different angle than ray 1 because the light was refracted, or bent, as the light reached a glass surface.

Summary annotation statement:

Part a identifies and describes two different light wave behaviors, reflection and refraction, and connects each one to all of its corresponding examples in the diagram. In part b, this response correctly describes two differences between Ray 1 and Ray 3, including a loss of intensity due to splitting of the electromagnetic energy and a change in the angle due to the light bending across the interface of a different material. This response is thorough and receives a score of 4.

Ⓐ From Ray 1 to Ray 2 the light is being reflected off the face of the glass at the same angle which it hit. Then from Ray 1 to Ray 3, because not all light is reflected by glass, some of the light travels thru. the glass, but at a slightly different angle. This occurs due to light refraction.

Ⓑ Ray 1 is coming from some light source and is traveling through the air to hit the face of the glass. Ray 3 occurs when the light does hit the glass, and some of the light is refracted into the glass. The glass changes the angle at which the light travels, because glass particles allow light to travel differently than air particles.

Summary annotation statement:

Part a identifies and describes two wave behaviors, reflection and refraction, and references specific evidence from the diagram to support the answer. Part b correctly describes one difference between Ray 1 and Ray 3 referencing the changed angle and explaining the difference because "glass particles allow light to travel differently than air particles." A second difference is not identified. This response is general and receives a score of 3.

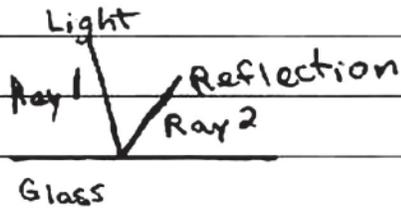
a) Reflection is taking place in the diagram because ray 1 bounced off the glass and reflected into ray 2. This also occurred with ray 3 and 4 because ray 3 bounced off the opaque material and went to a different direction in ray 4.

b) Some differences between ray 1 and ray 3 are the angles. After ray 1 hit the glass, the angle changed. Another difference is that the light from ray 1 split into two diff ways. It split to ray 2 which did not go through the glass and also ray 3 which did go through the glass.

Summary annotation statement:

In part a, one wave behavior, reflection, is identified and described with support from the diagram. A second wave behavior is not identified. In part b, one difference between Ray 1 and Ray 3 is described, indicating that, "the angle changed." The second difference between Ray 1 and Ray 3 further describes the diagram but not a difference between the two rays. This response is limited and receives a score of 2.

a Ray 1 is the illuminations of the glass.
Ray 2 is the reflection of the source of light from Ray 1



b Ray 1 is pure light and Ray 2 is distorted light changing the speed and appearance of it

Summary annotation statement:

Part a offers one wave behavior indicating, "Ray 2 is the reflection of the source of light from Ray 1." "[Illuminations]" is not a light wave behavior. In part b, "Ray 1 is pure light and Ray 2 is [distorted] light" does not adequately describe the difference between Ray 1 and Ray 2. This response is minimal and receives a score of 1

A- From Ray 3 to 4 is connected to energy.

R- Ray 1 is in the air Ray 3 is connected to energy.

Summary annotation statement:

This response offers no information that is relevant to the wave behaviors illustrated in the diagram. No credit is earned.